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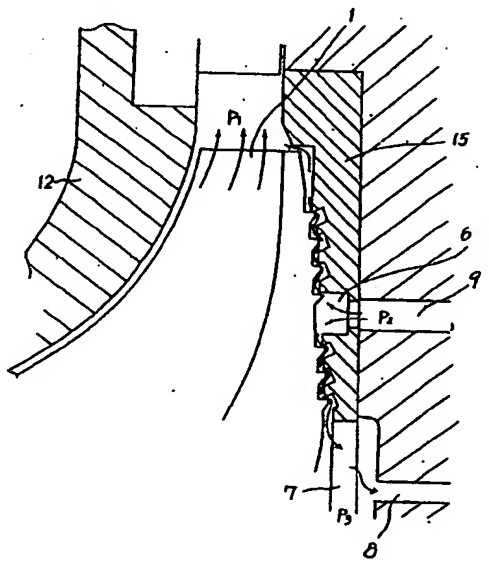
(54) Centrifugal compressor.

(57) Herein disclosed is a centrifugal compressor, in which a seal member (15) is arranged annularly and multiplexly at the back of an impeller for sealing up a gap between the impeller exit and back and forming an annular space (6), and in which the annular spacer is fed with a cold gas under a higher pressure than that at the impeller exit, so that the centrifugal compressor may have its impeller back cooled down.

Fig. 2



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BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a centrifugal compressor to be applied, for example, as a supercharger of an engine.

Description of the Prior Art

Fig. 3 is a longitudinal section showing the structure of a centrifugal compressor of the prior art, and Fig. 4 is a section for explaining the operations of the same. At the back of an impeller 1 of the centrifugal compressor and a casing 12, as shown, there is sandwiched a labyrinth packing 5 which seals up a seal space 7 between the exit and back of the impeller 1. The seal space 7 is vented to the outside through a ventilation hole 8 for releasing a slight amount of air, which comes into the seal space 7 along the labyrinth packing 5, to the outside thereby to drop the pressure in the seal space 7. As a result, the pressurized air at the exit of the impeller 1 is prevented from leaking to the back of the impeller 1 and accordingly from establishing a thrust pushing a rotor shaft 2 toward the entrance of the impeller 1. Thus, the facial pressure upon a main thrust bearing 3 is lowered to lighten a load upon the main thrust bearing 3. Reference numerals 11 and 4 designate a thrust collar and a thrust resisting bearing, respectively.

In the existing centrifugal compressor described above, the air temperature at the exit of the impeller 1 becomes the higher at the higher pressure ratio of the centrifugal compressor. Even in case the air at the room temperature is sucked, for example, its temperature reaches 200° C or more at exit of the impeller 1 if the pressure ratio is about 4.0. This hot air is additionally heated, while passing through the labyrinth packing 5, by the heat of friction which is produced by the rotations of the fins of the labyrinth packing 5 so that the impeller 1 has its back heated. The centrifugal compressor of this single stage type inhaling the atmospheric air usually has its impeller made of an aluminum alloy, and the impeller 1 has its strength degraded due to its temperature rise when heated by the air at its back. This make it difficult to retain the high pressure ratio if it is made of an aluminum alloy. The temperature rise of the impeller 1 in turn leads to a rise in the air temperature, thus causing an efficiency drop of the compressor.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a centrifugal compressor which can solve the above-specified difficulty.

According to the present invention, there is provided a centrifugal compressor which comprises: an impeller; a seal member arranged annularly and multiplexly at the back of said impeller for sealing up a gap between the exit of said impeller and a space at the back of said impeller and for forming an annular space; and a passage for feeding a cold gas under a higher pressure than that at the exit of said impeller into said annular space.

In the centrifugal compressor according to the present invention, the seal member is so arranged annularly and multiplexly at the back of the impeller that it seals up the gap between the exit of the impeller and a space at the back of the impeller and forms the annular space. This annular space is fed through the passage with a cold gas under a higher pressure than that at the exit of the impeller. Since the cold gas fed through the passage has a higher pressure than that at the exit of the impeller, the hot gas at the impeller exit is prevented from flowing into the space at the impeller back, but a small amount of cold gas will flow out of the space toward the impeller exit. As a result, the back of the impeller is not heated by the gas at the impeller exit but cooled by the cold gas fed through the passage.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects, features and advantages of the present invention will become apparent from the following description to be made with reference to the accompanying drawings, in which:

Fig. 1 is a longitudinal section showing a centrifugal compressor according to one embodiment of the present invention;

Fig. 2 is a section for explaining the operations of the same;

Fig. 3 is a longitudinal section showing the centrifugal compressor of the prior art; and

Fig. 4 is a section for explaining the operations of the same.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Fig. 1 shows the structure of a centrifugal compressor according to one embodiment of the present invention, and Fig. 2 illustrates the operations of the centrifugal compressor. As shown, the centrifugal compressor according to the present embodiment is used as a supercharger of an engine. Between the back of an impeller 1 and a casing 12, as shown in Fig. 1, there is sandwiched a labyrinth packing 15 for sealing up a seal space 7 between the exit and back of the impeller 1. The seal space 7 is vented to the outside through a

ventilation hole 8 for releasing a slight amount of air, which comes into the seal space 7 along the labyrinth packing 5, to the outside thereby to drop the pressure in the seal space 7. As a result, the pressurized air at the exit of the impeller 1 is prevented from leaking to the back of the impeller 1 and accordingly from establishing a thrust pushing a rotor shaft 2 toward the entrance of the impeller 1. Thus, the facial pressure upon a main thrust bearing 3 is lowered to reduce a load upon the main thrust bearing 3. Reference numerals 11 and 4 designate a thrust collar and a thrust rosisting bearing, respectively.

The air temperature at the exit of the impeller 1 is the higher at the higher pressure ratio of the centrifugal compressor. Even in case the air at the room temperature is sucked, for example, its temperature reaches 200 °C or more at exit of the impeller 1 if the pressure ratio is about 4.0. In order that the back of the impeller 1 may be prevented from being heated by that hot temperature, the labyrinth packing 15 of the present centrifugal compressor has its fines classified into two outer and inner groups, which form an annular space 6 inbetween. This annular space 6 is fed, as better seen from Fig. 2, through an air passage 9 from the outside with the cold air which has a higher pressure P_2 than a pressure P_1 at the exit of the impeller 1. Generally speaking, the air having left the centrifugal compressor has a higher pressure than that P_1 at the exit of the impeller 1, like the compressed cold air under a high pressure to be fed from the supercharger through a cooler to the engine, and the compressed air is cooled down by an air cooler before it is used. Thus, this cooled air may be guided to the labyrinth packing 15 at the back of the impeller 1.

At the labyrinth packing at the back of the impeller of the existing centrifugal compressor, the air in the inside seal space is released to have its pressure dropped so that the air at the impeller exit will pass in a small amount through the labyrinth packing. On the contrary, the labyrinth packing 15 of the present centrifugal compressor has two outer and inner groups of fins and its intervening annular space 6 fed with the air under the higher pressure P_2 than the pressure P_1 at the exit of the impeller 1. Thus, the air thus fed has the higher pressure P_2 so that the air at the exit of the impeller 1 will not flow along the labyrinth packing 15 into the annular space 6. To the contrary, a small amount of air fed to the annular space 6 will flow toward the exit of the impeller 1. As a result, the back of the impeller 1 is not exposed to and accordingly heated by the air, which might otherwise flow from the exit of the impeller 1, but is cooled by the cold air fed from the outside via the air passage 9. Thus, the impeller 1 can have its temperature rise suppressed so that its strength can be prevented from being degraded by the temperature rise. Incidentally, since the seal space 7 at the back of the impeller 1 and the annular space 6 are sealed up by the labyrinth packing 15, the air flow, if any to the seal space 7, is released from the ventilation hole 8 to drop a pressure P_3 in the seal space 7. Thus, the load upon the main thrust bearing 3 is not increased by the balanced thrust unlike the centrifugal compressor of the prior art.

According to the aforementioned structure of the centrifugal compressor of the present invention, the impeller back is not heated by the gas at the impeller exit but is cooled down by the cold gas. As a result, the high pressure ratio can be retained even if the impeller is made of an aluminum alloy, and the temperature of the gas to be compressed by the impeller can be dropped to raise the compression efficiency.

Claims

1. A centrifugal compressor characterized in comprising: an impeller (1); a seal member (15) arranged annularly and multiplexly at the back of said impeller for sealing up a gap between the exit of said impeller and a space (7) at the back of said impeller and for forming an annular space (6); and a passage (9) for feeding a cold gas under a higher pressure than that at the exit of said impeller into said annular space.

2. A centrifugal compressor according to Claim 1, wherein said cold gas under a high pressure is the air at the exit of an engine air cooler.

3. A centrifugal compressor according to Claim 1, wherein said seal member (15) is disposed at both the outer and inner circumferences of said annular space (6).

Fig. 1

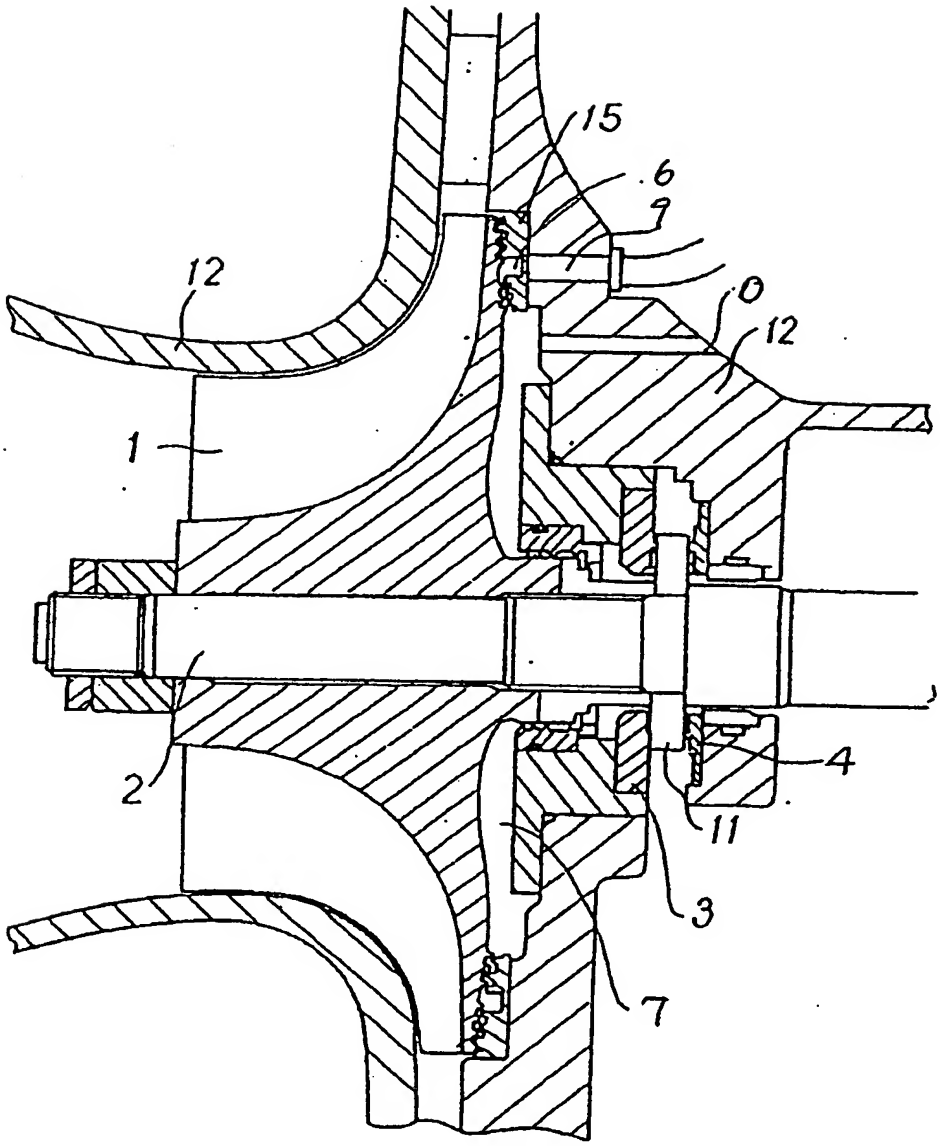


Fig. 2

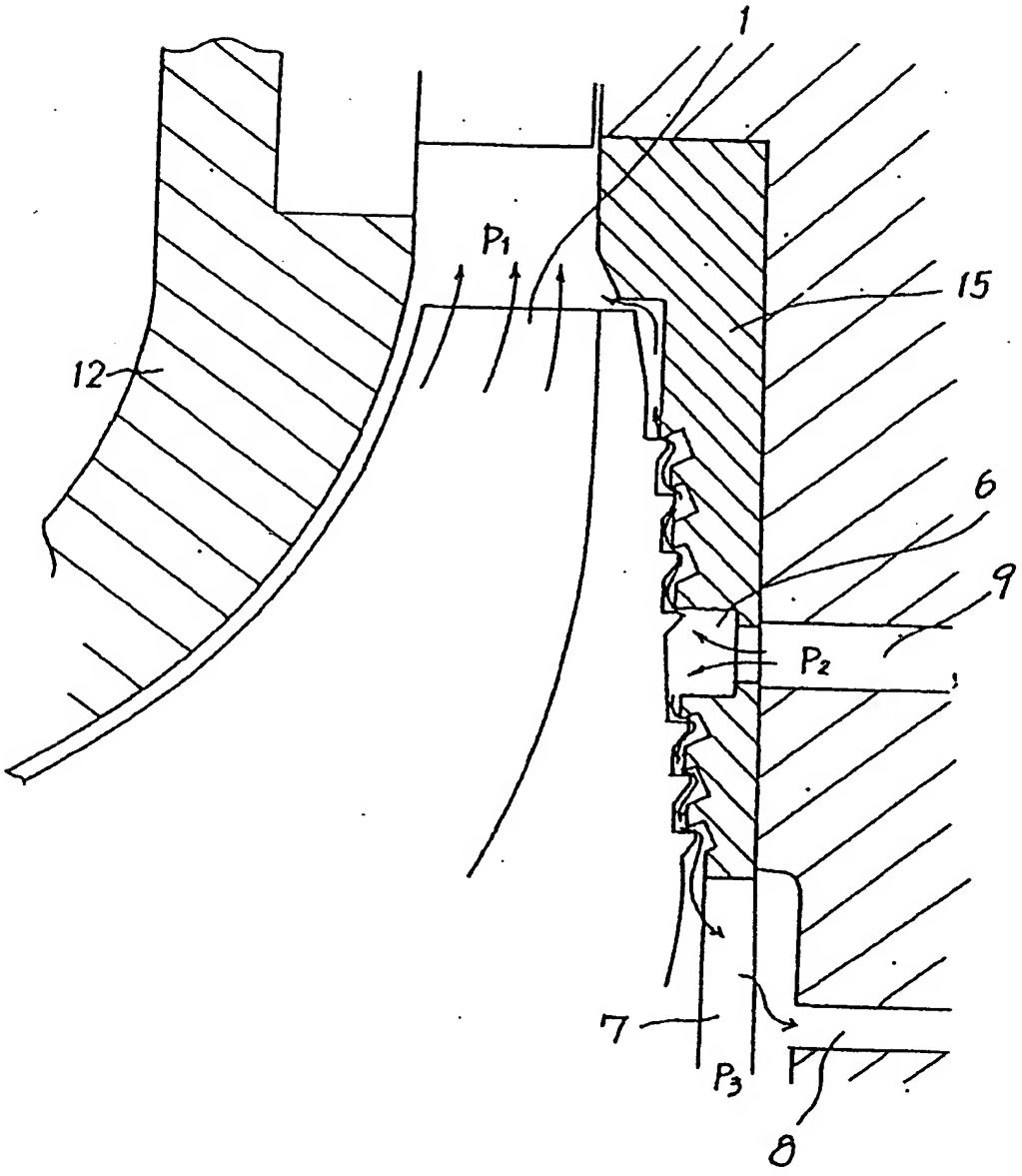


Fig. 3 (Prior Art)

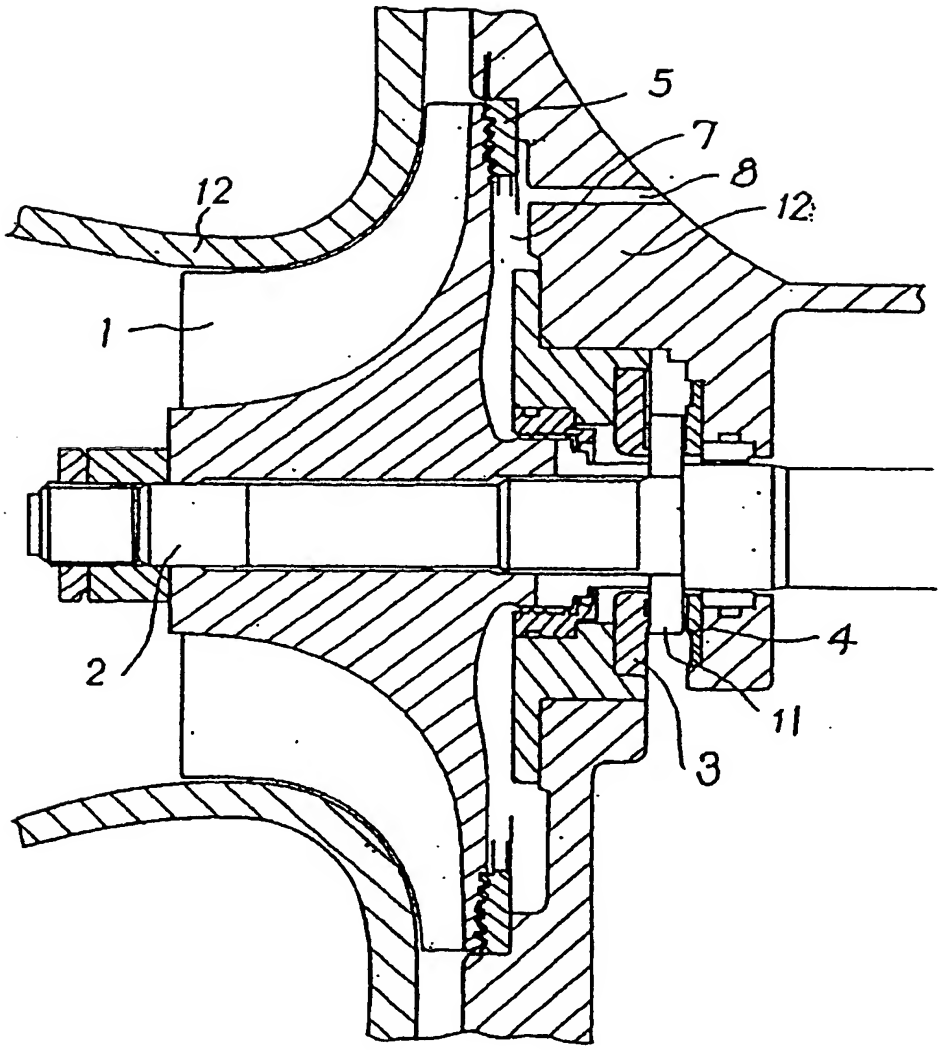
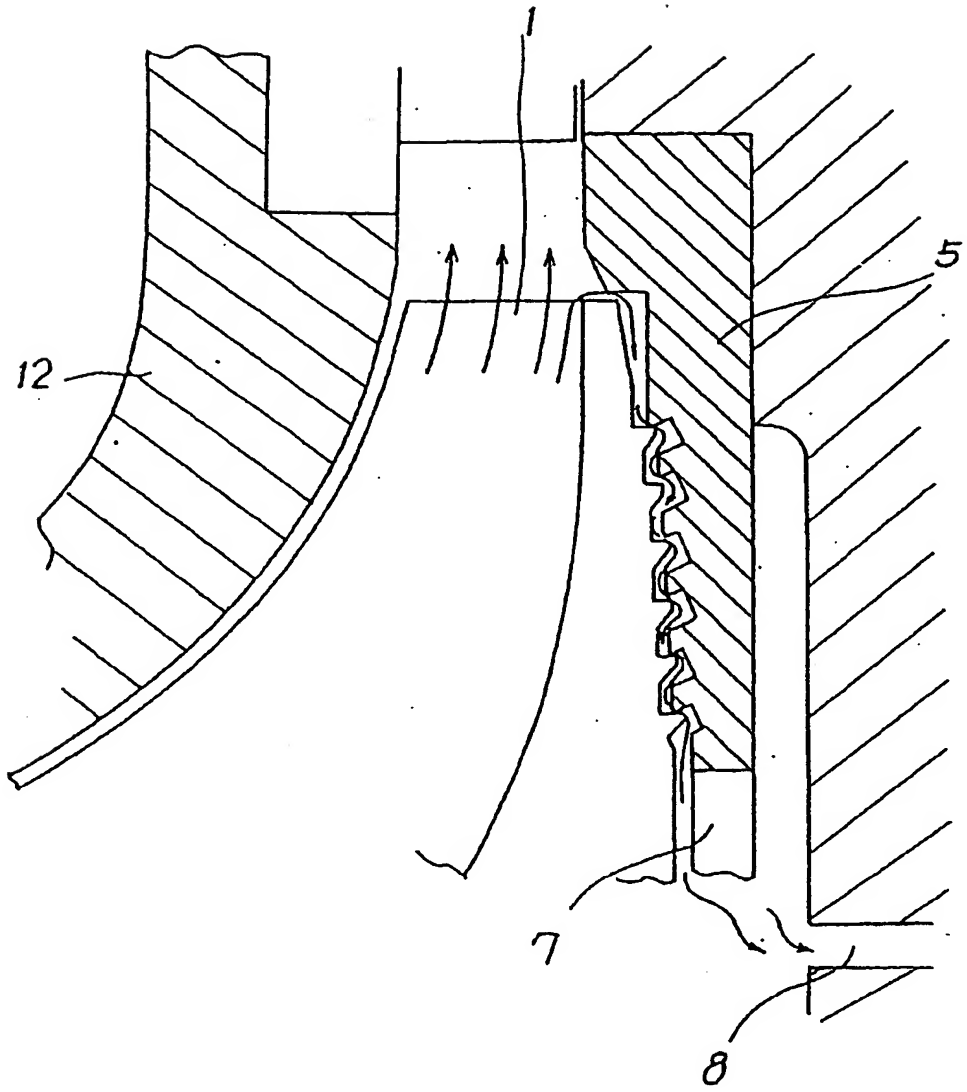


Fig. 4 (Prior Art)



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EUROPEAN SEARCH REPORT

Application Number

EP 92 10 6288

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	DE-C-249 336 (GUTEHOFFNUNGSHÜTTE) * the whole document *	1	F04D29/16 F04D29/58
A	FR-A-379 125 (EYERMANN) * the whole document *	1	
A	US-A-3 650 634 (OSBORNE) * the whole document *	1-3	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

F04D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	10 AUGUST 1992	TEERLING J.H.

CATEGORY OF CITED DOCUMENTS

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